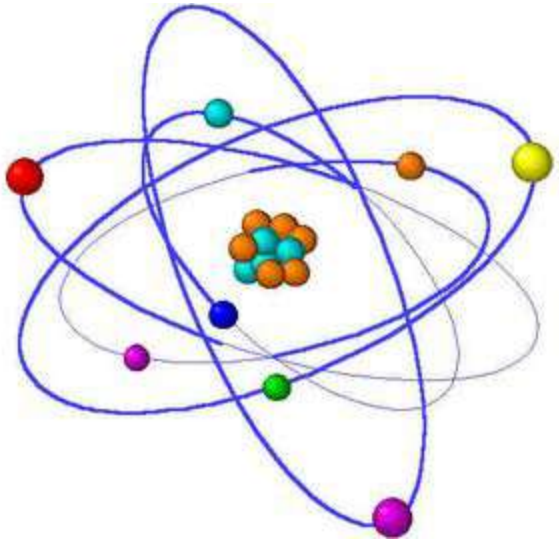
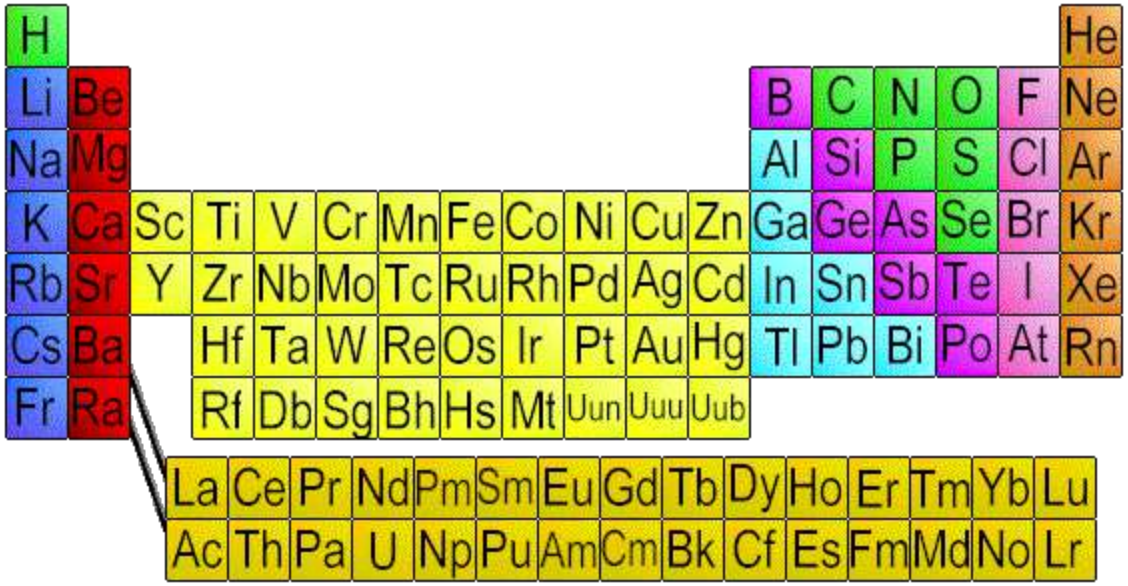
Basic Chemistry Review

Earth and Space Science

- Element: a substance that cannot be broken down into simpler chemical substances.

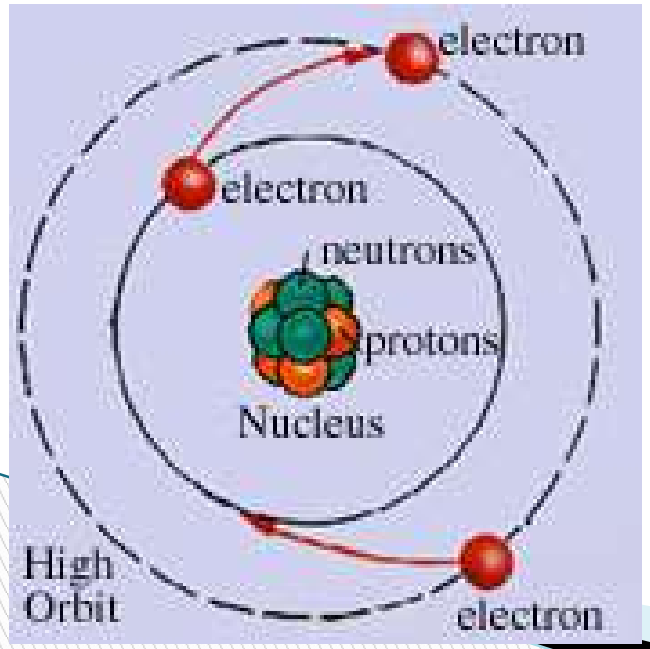
- Atom: smallest particle of an element that still has the properties of that element.





- Nucleus: center of an atom.
- Atomic nuclei are composed of 2 subatomic particles:

  Protons: → Positively charged
  → Large in size
  → The number of protons in the nucleus determines the identity of an element. This is the *atomic number* of the element.

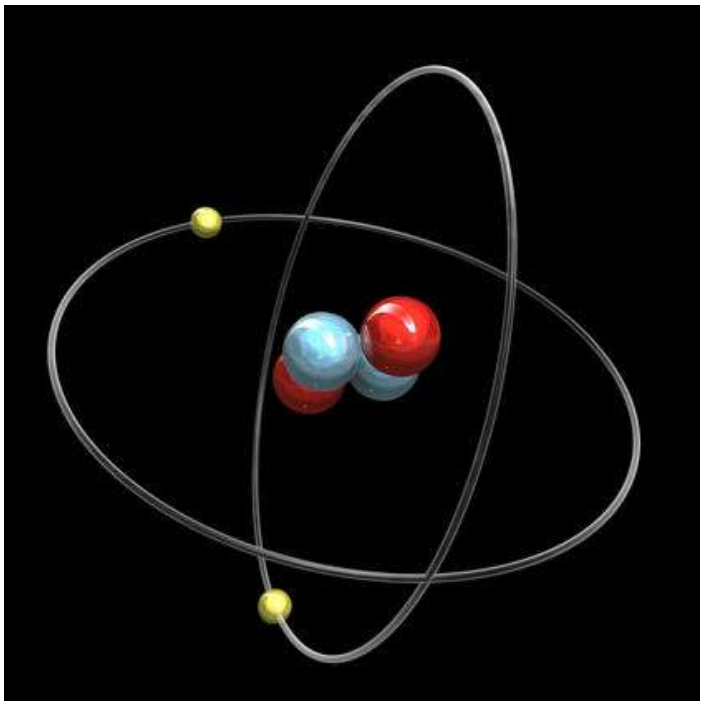


- Atomic number: The number of protons in the nucleus of an atom

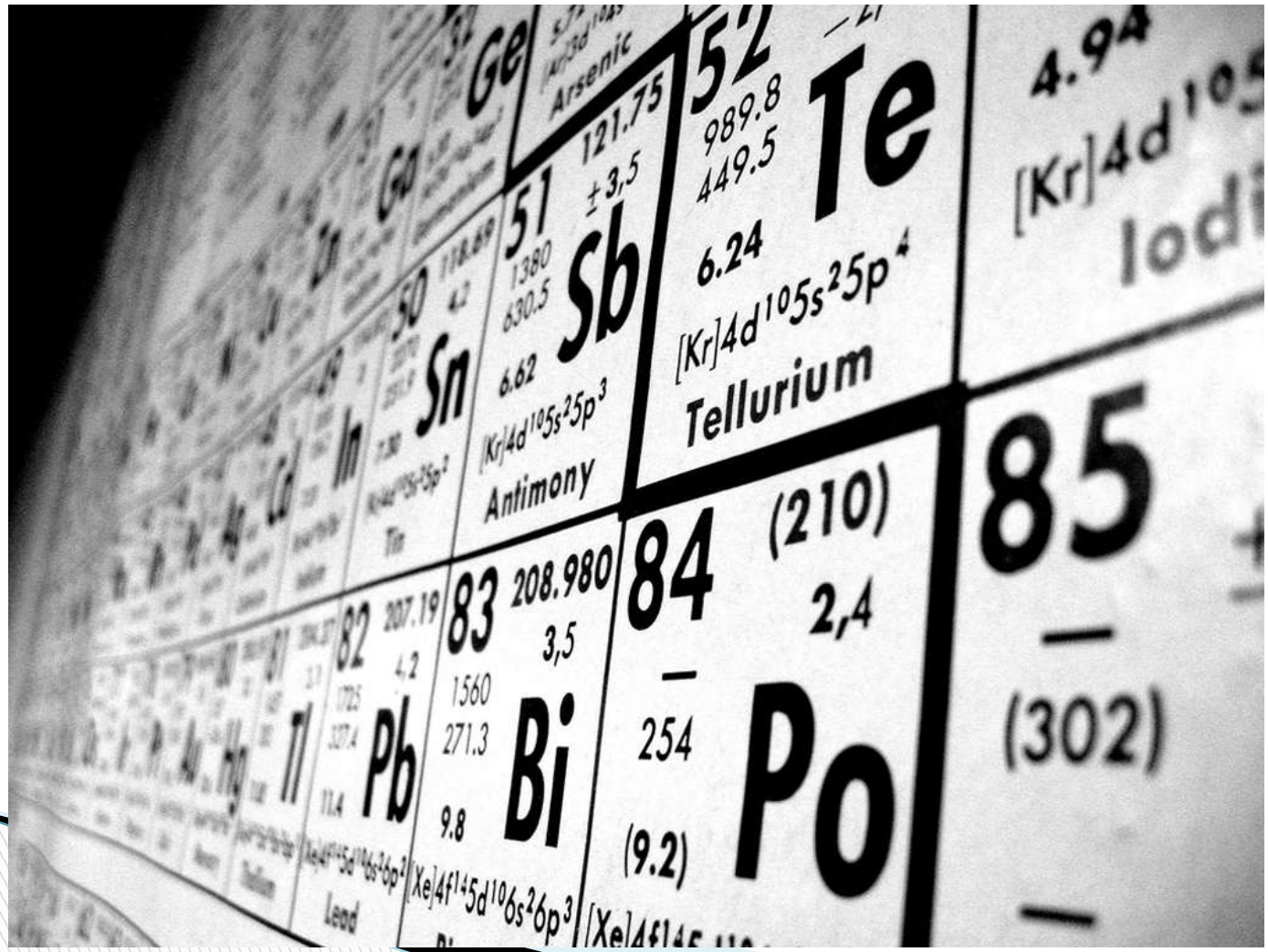
Neutrons: → Neutral charge

→ Same size as protons

→Neutrons add mass to the nucleus.

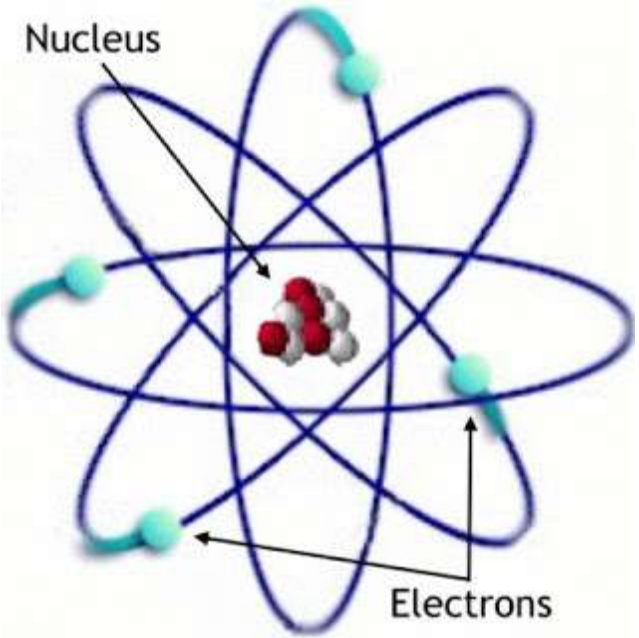


- Atomic Mass: The number of protons + the number of neutrons in the nucleus (sometimes referred to as the *mass number*)

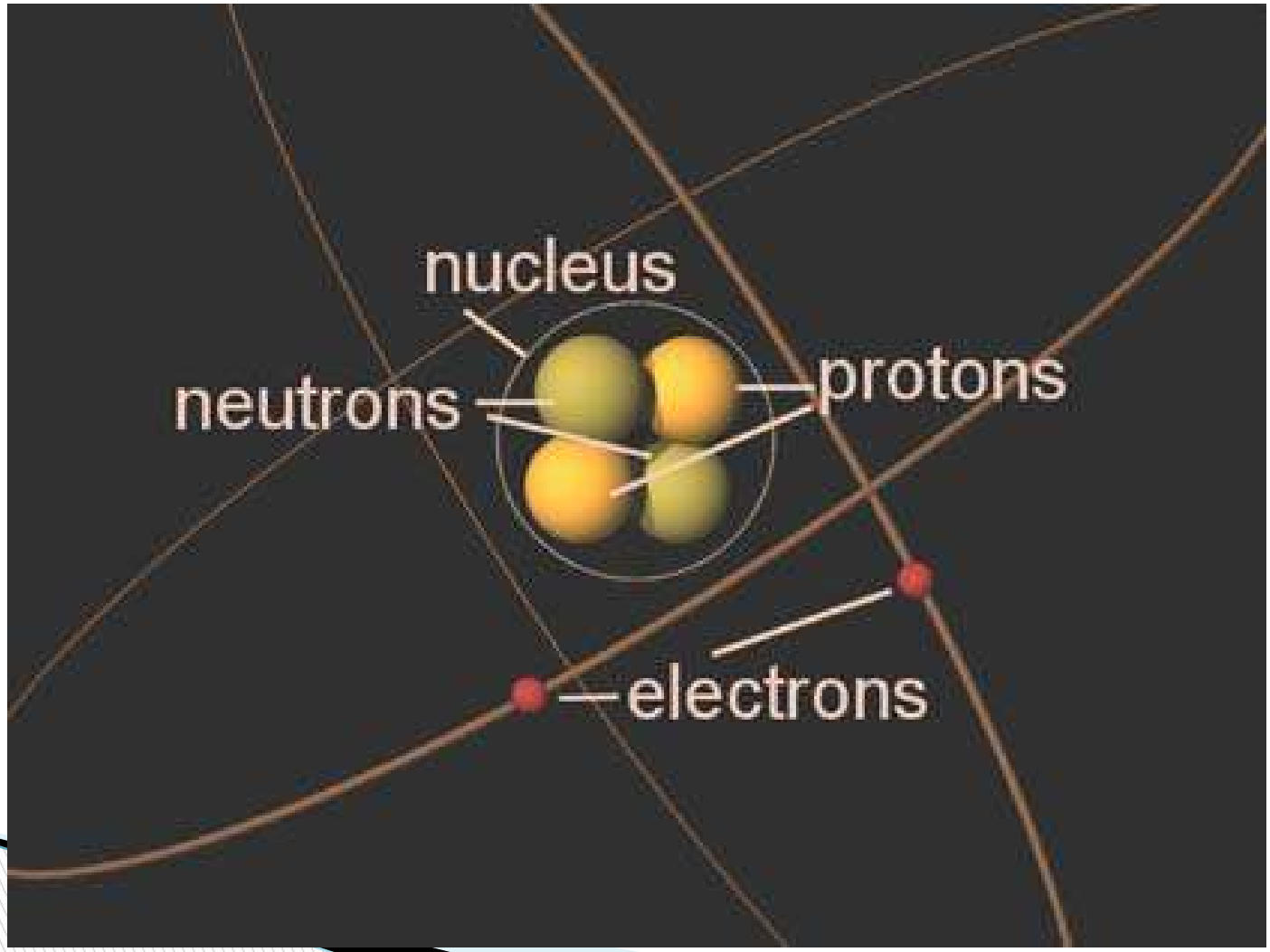


- Electrons are negatively charged particles that orbit the nucleus in an *electron cloud*, which is outside the nucleus, but totally surrounds the nucleus.

- Electrons are *very* small. They are so small the mass of an individual electron cannot be measured.

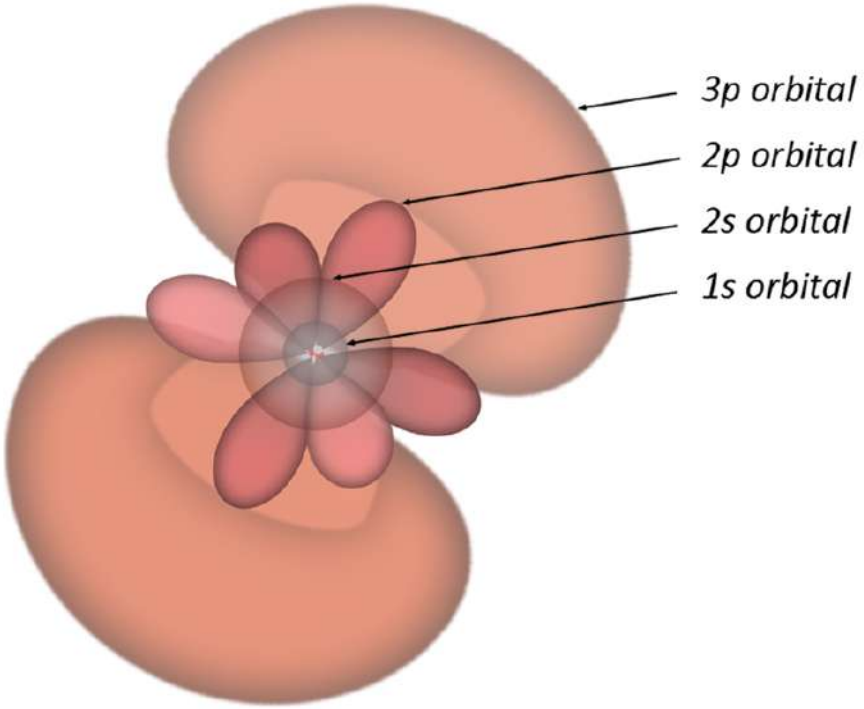


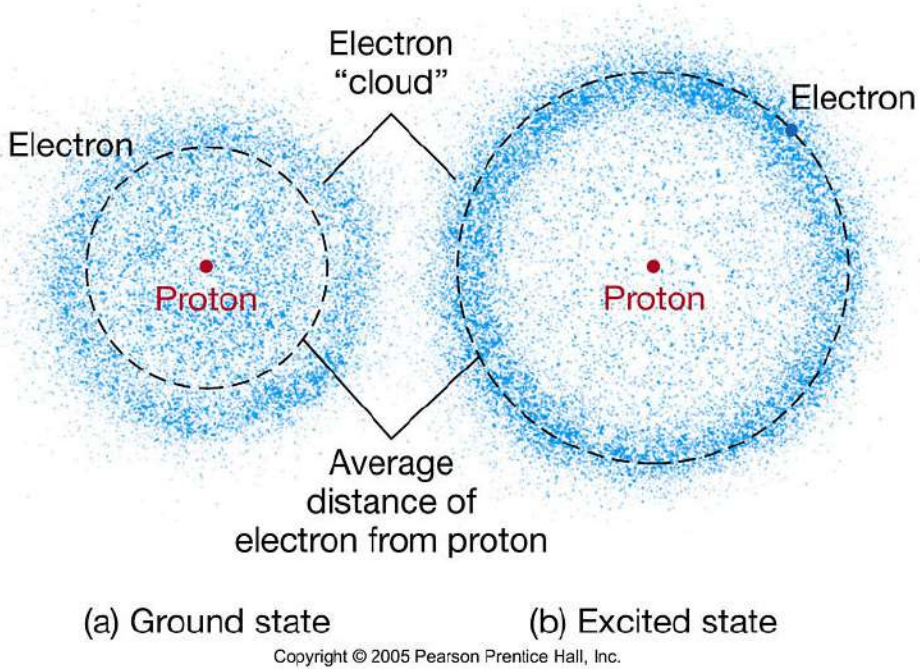
- In an atom, the number of protons=the number of electrons, atoms have no electric charge



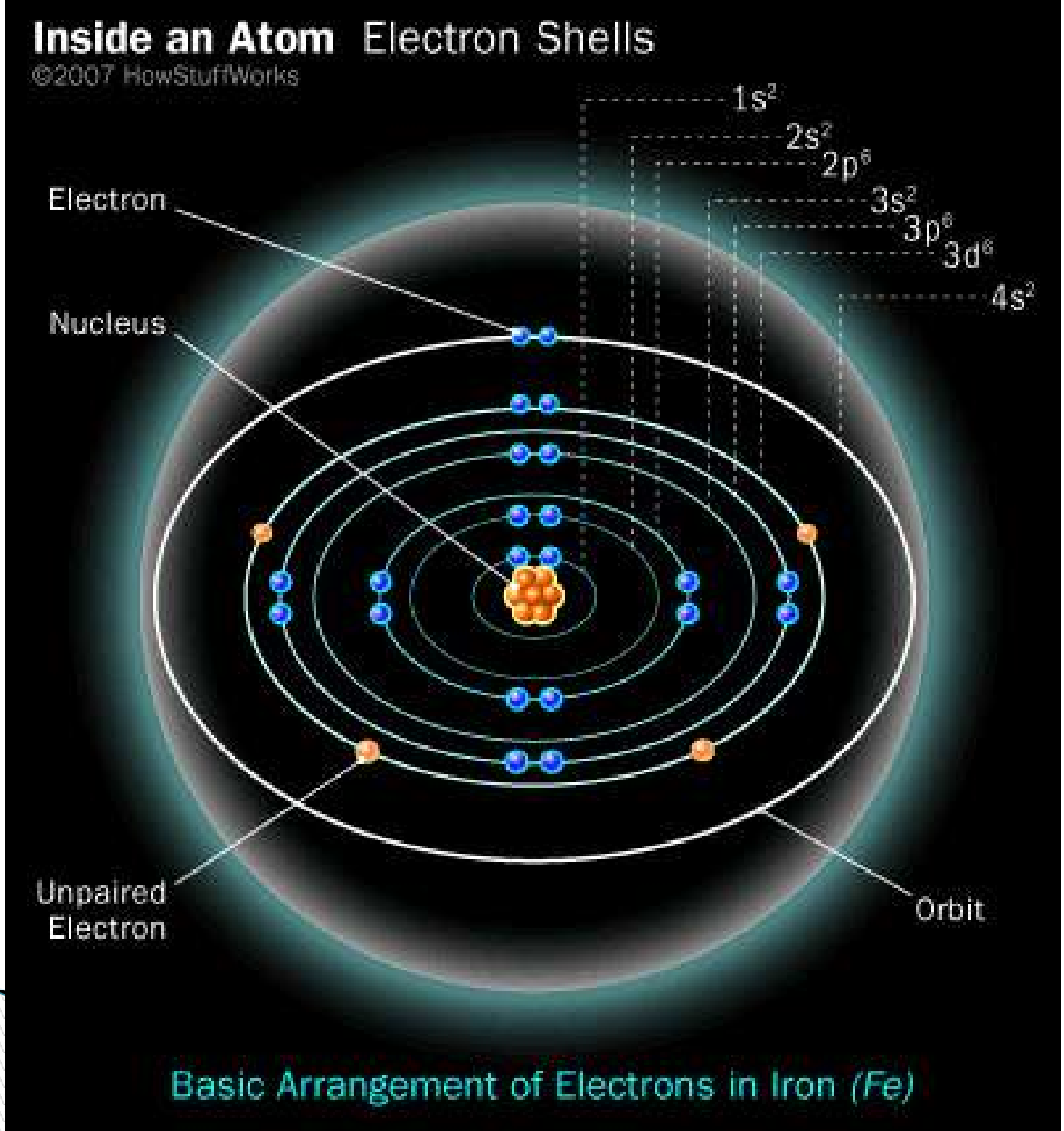
- The electron cloud is divided energy levels and within each energy level there are sublevels.

- Each energy level can hold a specific number of electrons:





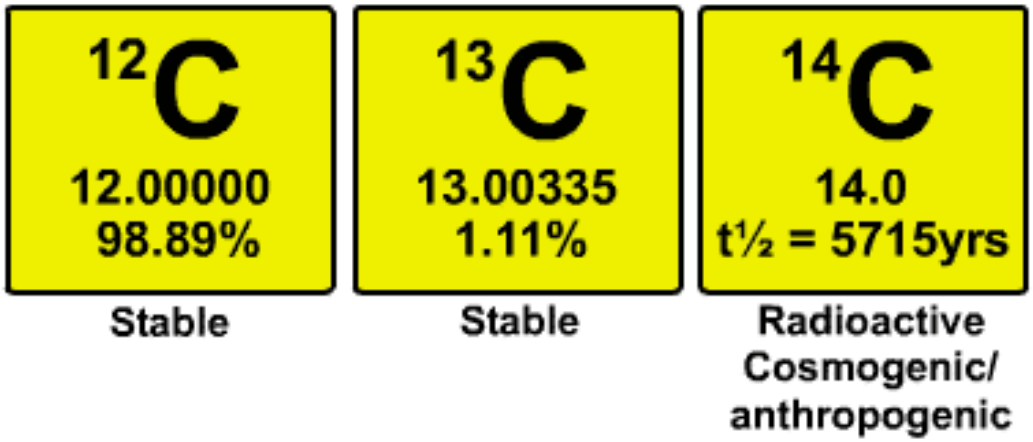
- 1st energy level holds up to 2 electrons (*s* sublevel holds both electrons)
- 2nd energy level holds up to 8 electrons (*s* sublevel holds 2 and the *p* sublevel holds 6)
- 3rd energy level holds up to 18 electrons (*s* holds 2, *p* holds 6 and the *d* sublevel holds 10)
- 4th energy level holds up to 32 electrons (*s* holds 2, *p* holds 6, *d* holds 10 and the *f* sublevel holds 14)


Inside an Atom Electron Shells
©2007 HowStuffWorks
1s²
2s²
2p⁶
3s²
3p⁶
3d⁶
4s²
Electron
Nucleus
Unpaired Electron
Orbit
Basic Arrangement of Electrons in Iron (Fe)

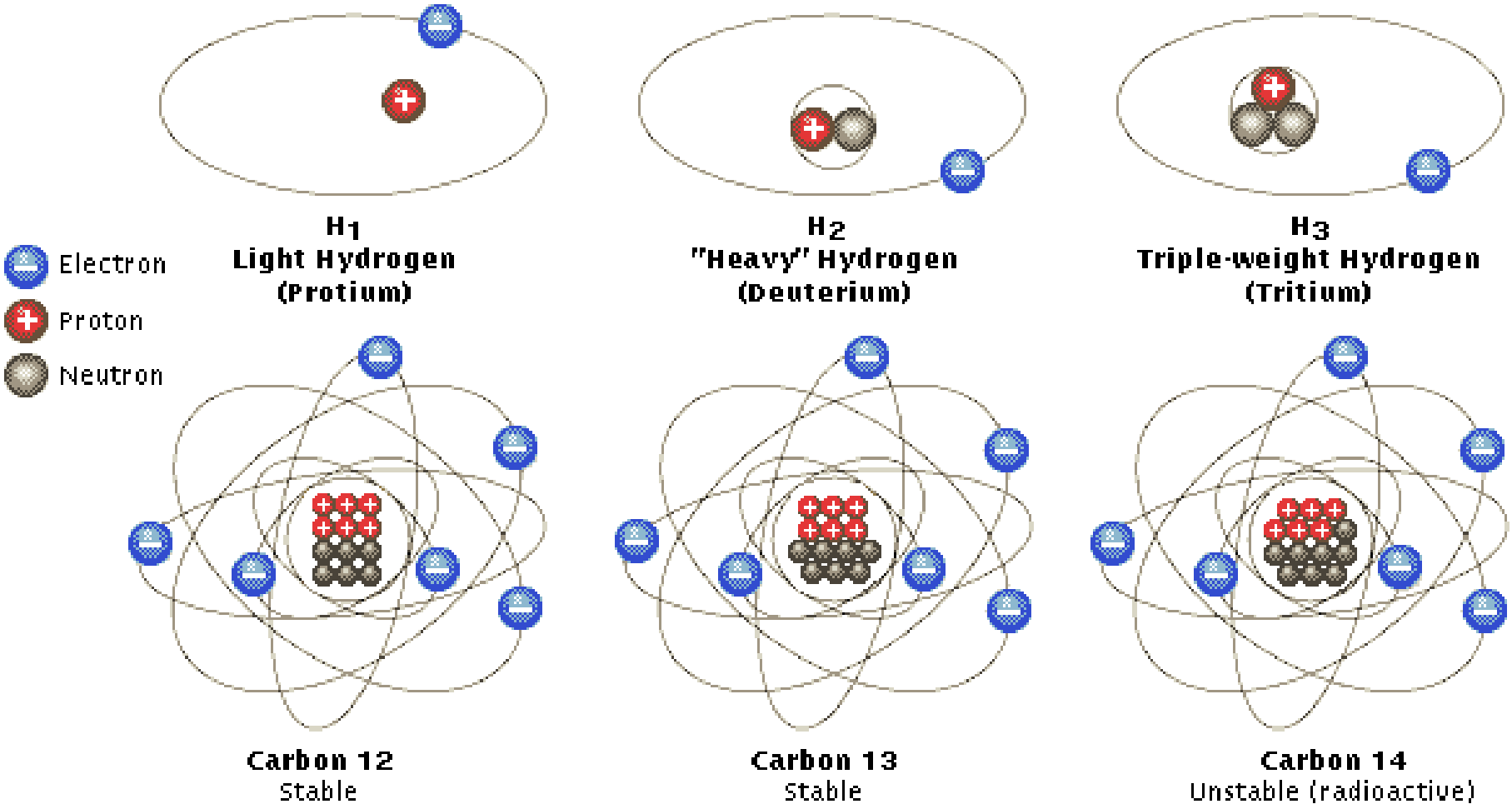
- Isotopes: atoms of the same element that have a differing number of neutrons in their nuclei.

- The different number of neutrons gives isotopes different atomic masses.

Ex. Carbon-12 6 protons, 6 neutrons
Carbon-14 6 protons, 8 neutrons

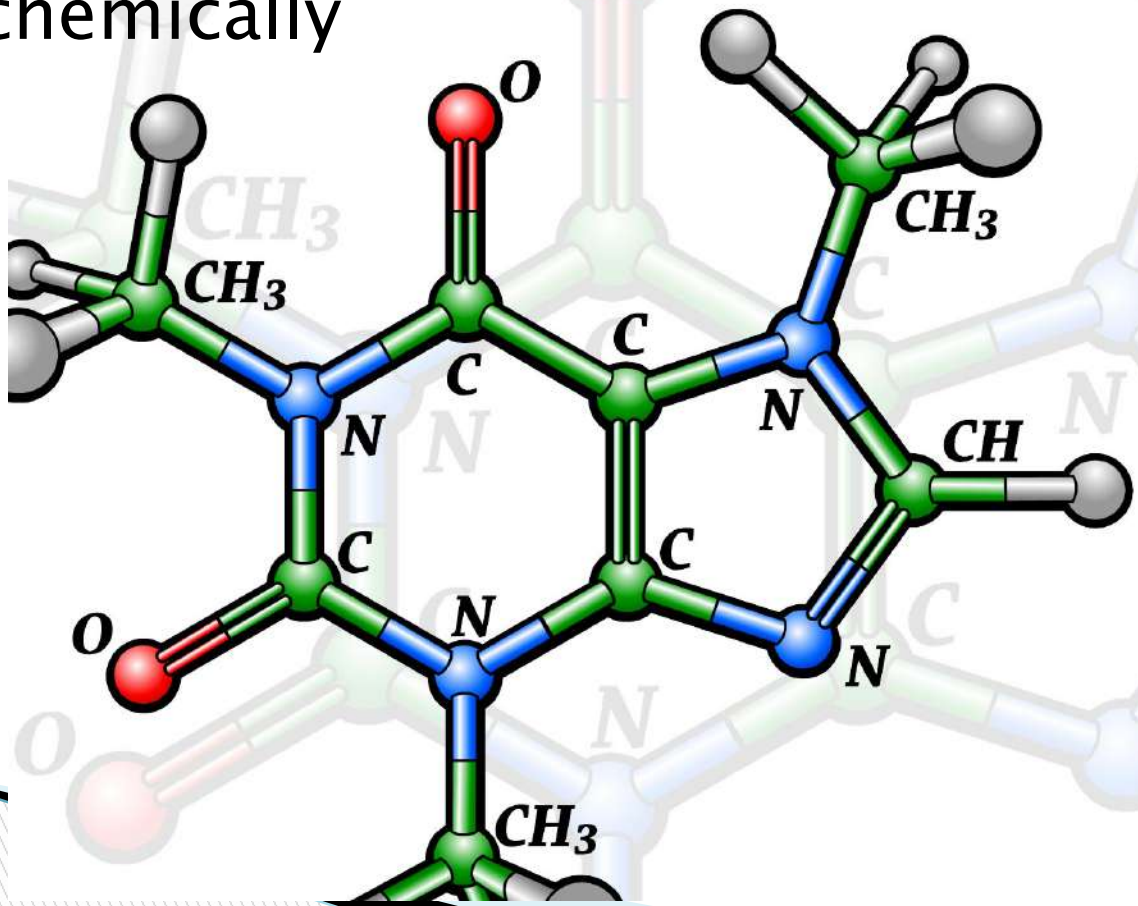


Isotopes of Hydrogen and Carbon



- **Chemical bonding and Chemical compounds**

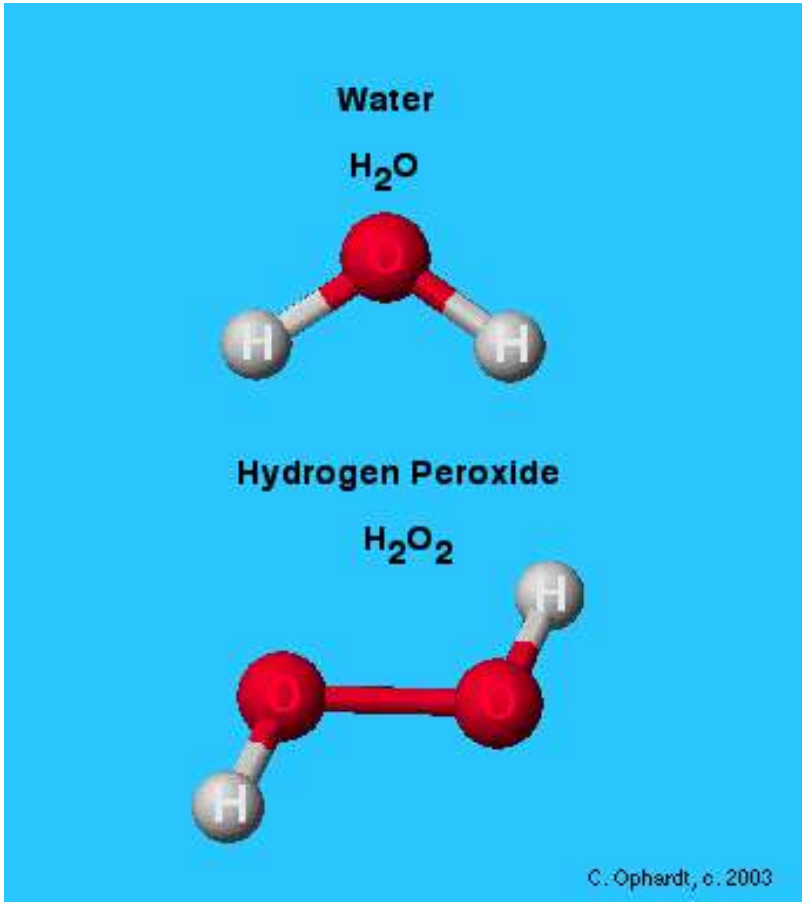
- Compound: substance composed of two or more elements that have been combined chemically

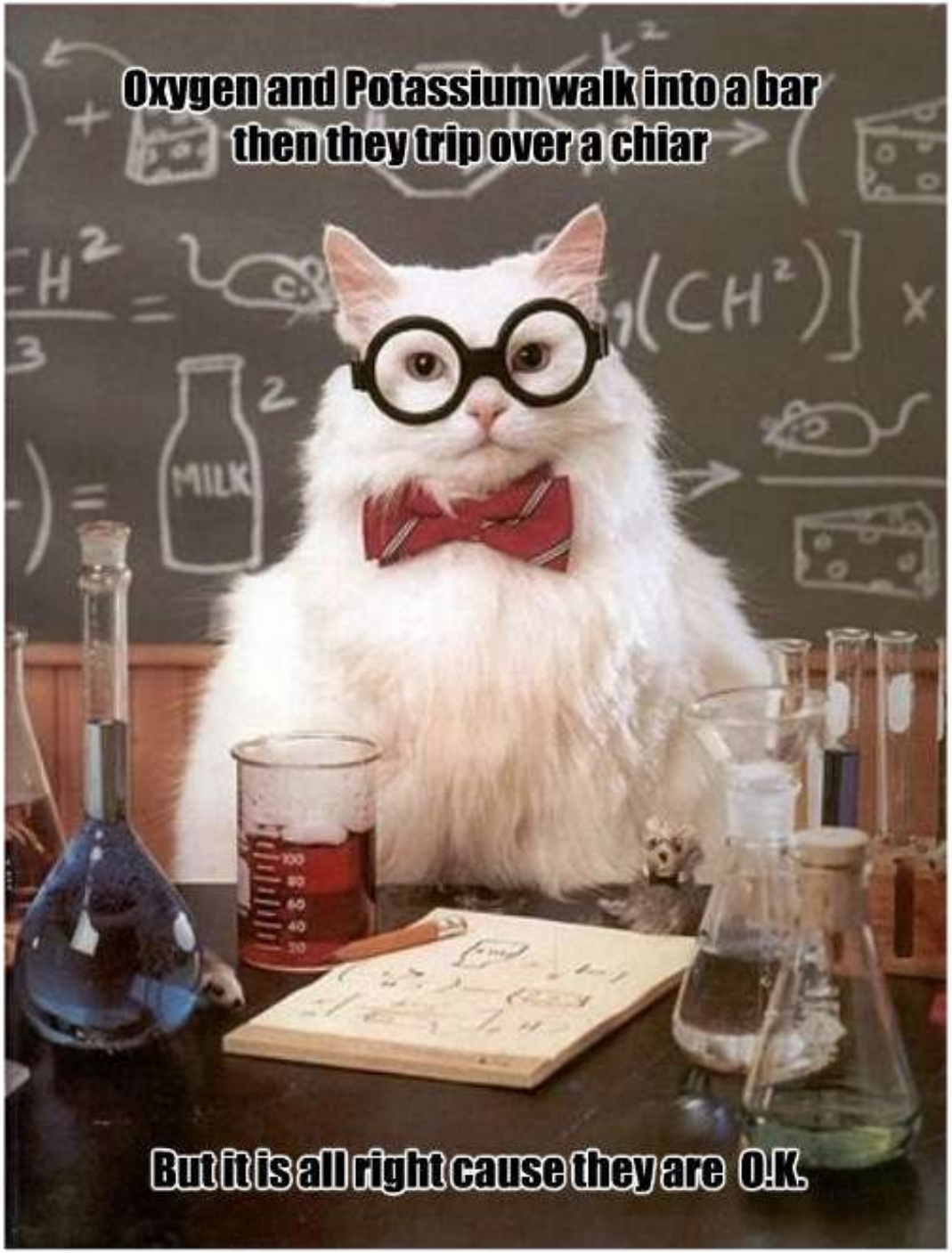


- The properties of a compound are different than the properties of the elements that make it up.

- Ex. $2H_2 + O_2 \rightarrow 2H_2O$

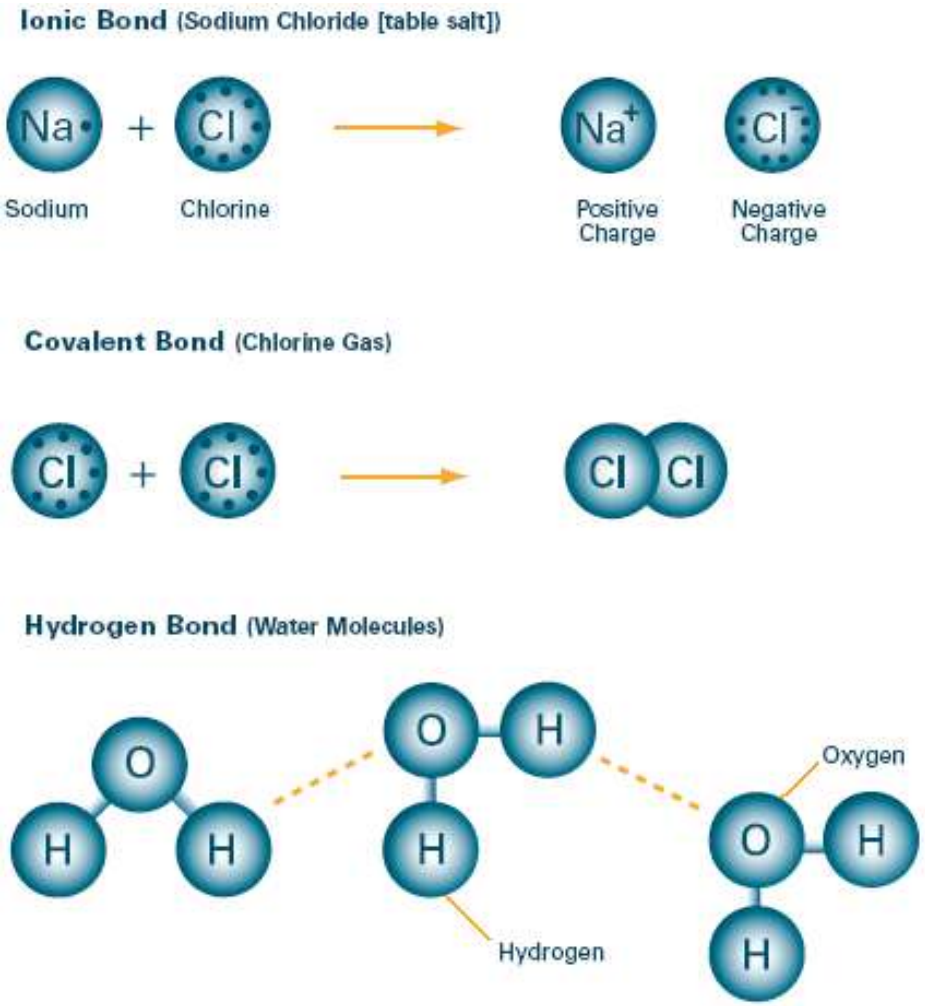
- H_2 and O_2 are both highly flammable, but water is used to put fires out.




Oxygen and Potassium walk into a bar
then they trip over a chiar
MILK
But it is all right cause they are O.K.

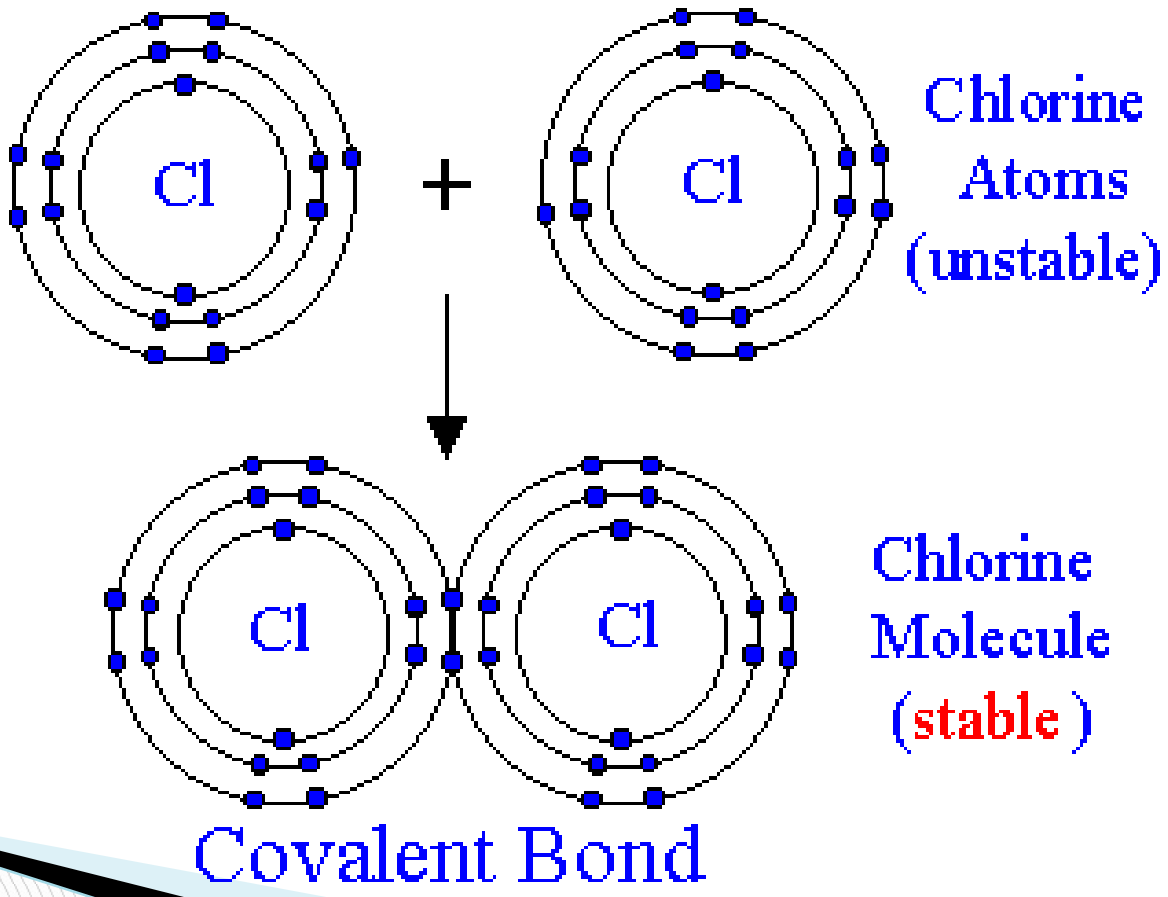
- Chemical bonds hold compounds together.

- There are two main types of chemical bonds:



- 1. Covalent bonds: form when atoms share electrons to form a compound.

→ Covalent bonds form molecules.



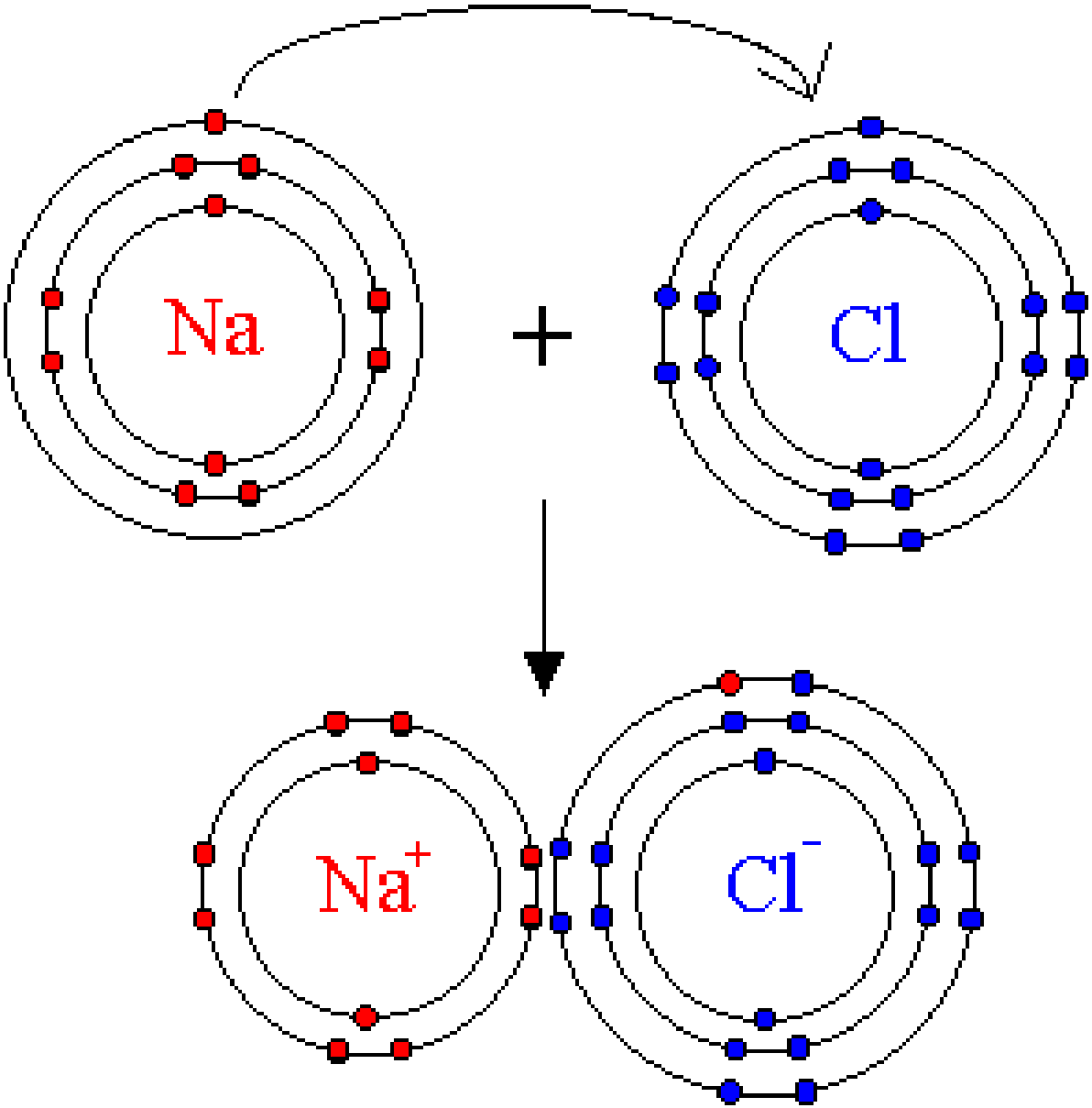
- 2. Ionic bonds: form when electrons are transferred from one atom to another.

→ Ions are atoms have gained or lost electrons, so they have an electrical charge.

→ Atoms that gain electrons have a negative charge, and are called *anions*

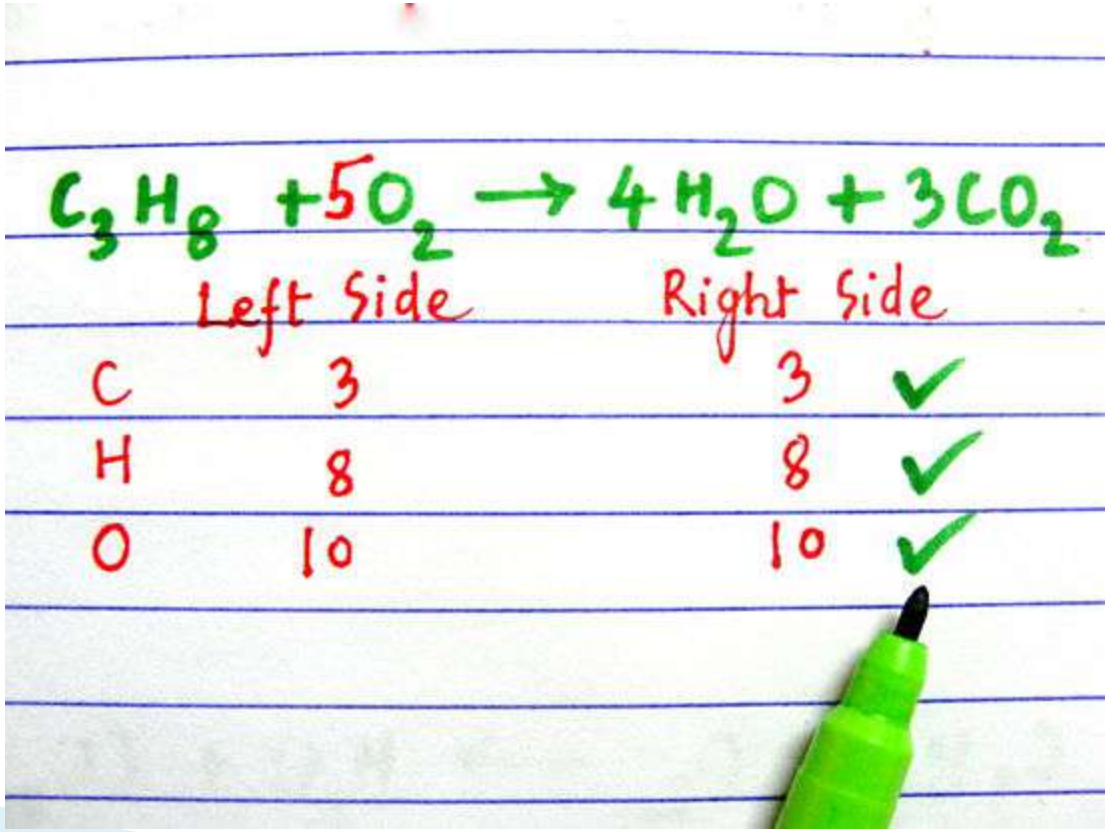
→ Atoms that lose electrons have a positive charge, and are called *cations*.

→ Ionic bonds *do not* form molecules.



Ionic Bond

- **Chemical equations**
- Chemical equations must obey the Law of Conservation of Matter, so the number of atoms available before a reaction must equal the number of atoms available after the reaction.

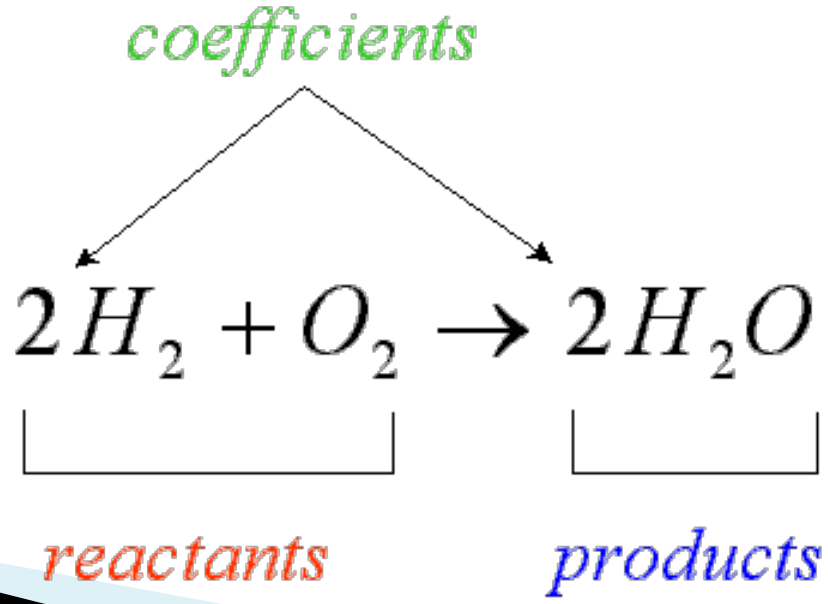


- This is called a balanced equation.

$$2H_2 + O_2 \rightarrow 2H_2O$$

4 atoms H_2
2 atoms O_2
6 atoms

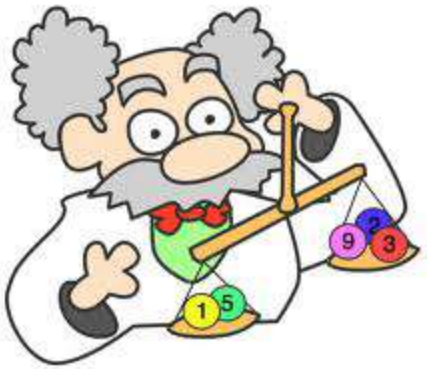
4 atoms H_2
2 atoms O_2
6 atoms

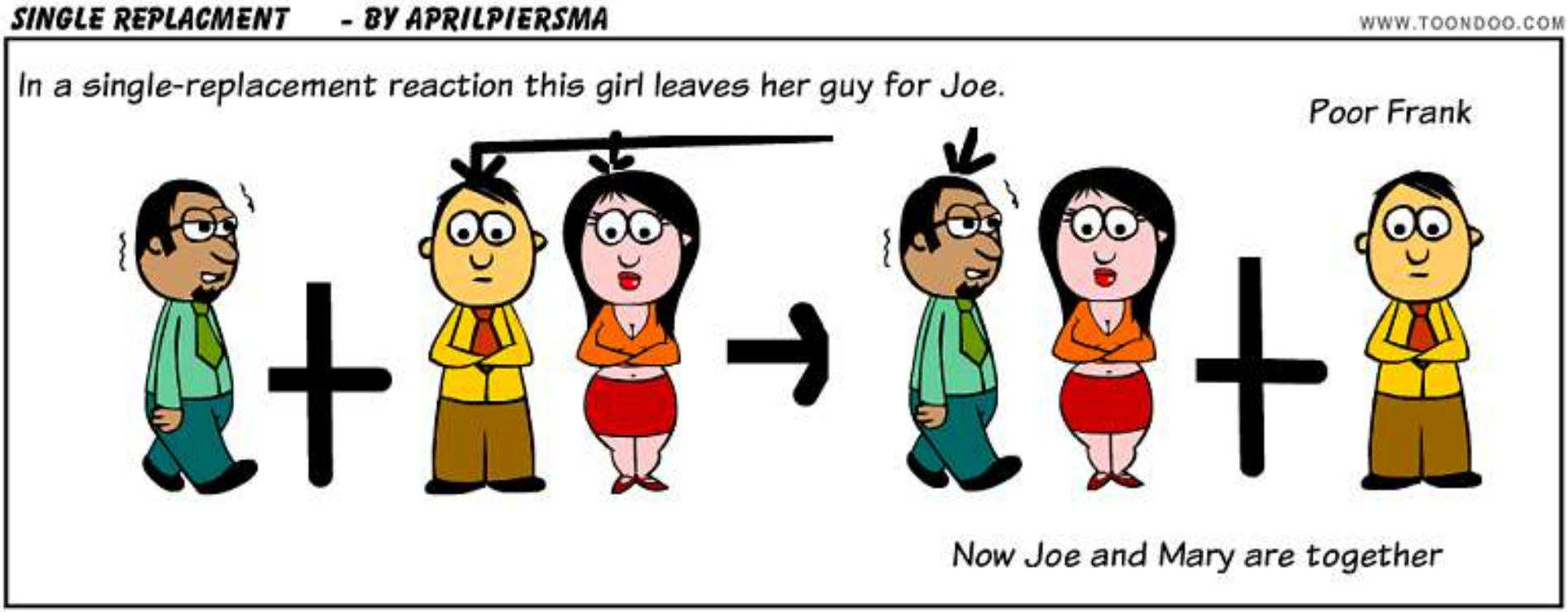


- Every chemical reaction has 2 parts: the reactants (that join together chemically) and the products (what is formed in the reaction.)

$$2H_2 + O_2 \rightarrow 2H_2O$$

reactants product



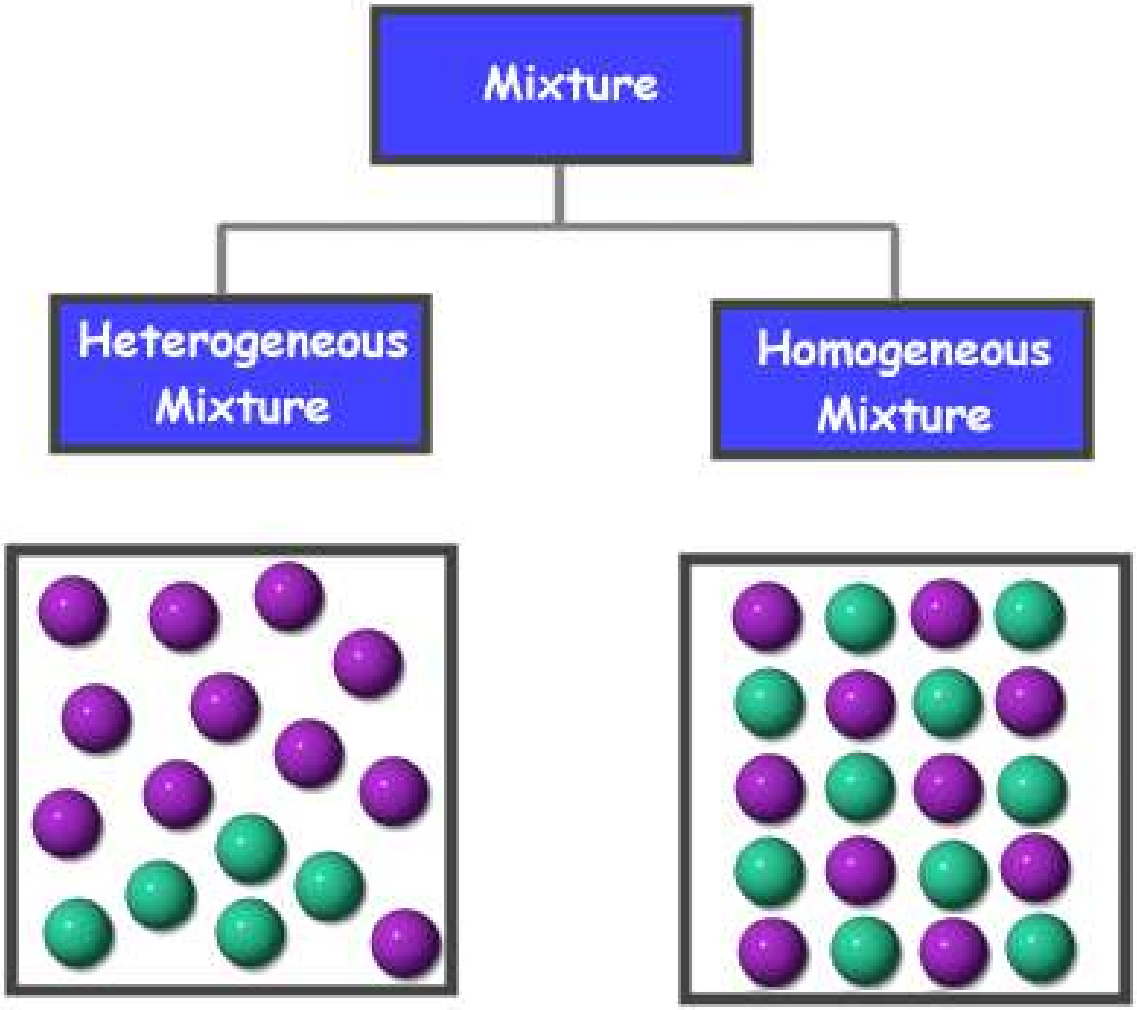

SINGLE REPLACMENT - BY APRILPIERSMA
WWW.TOONDOO.COM
In a single-replacement reaction this girl leaves her guy for Joe.
Poor Frank
Now Joe and Mary are together

- **Solutions and Mixtures**
- Mixture: combination of substances where the individual components retain their own properties.

Mixture

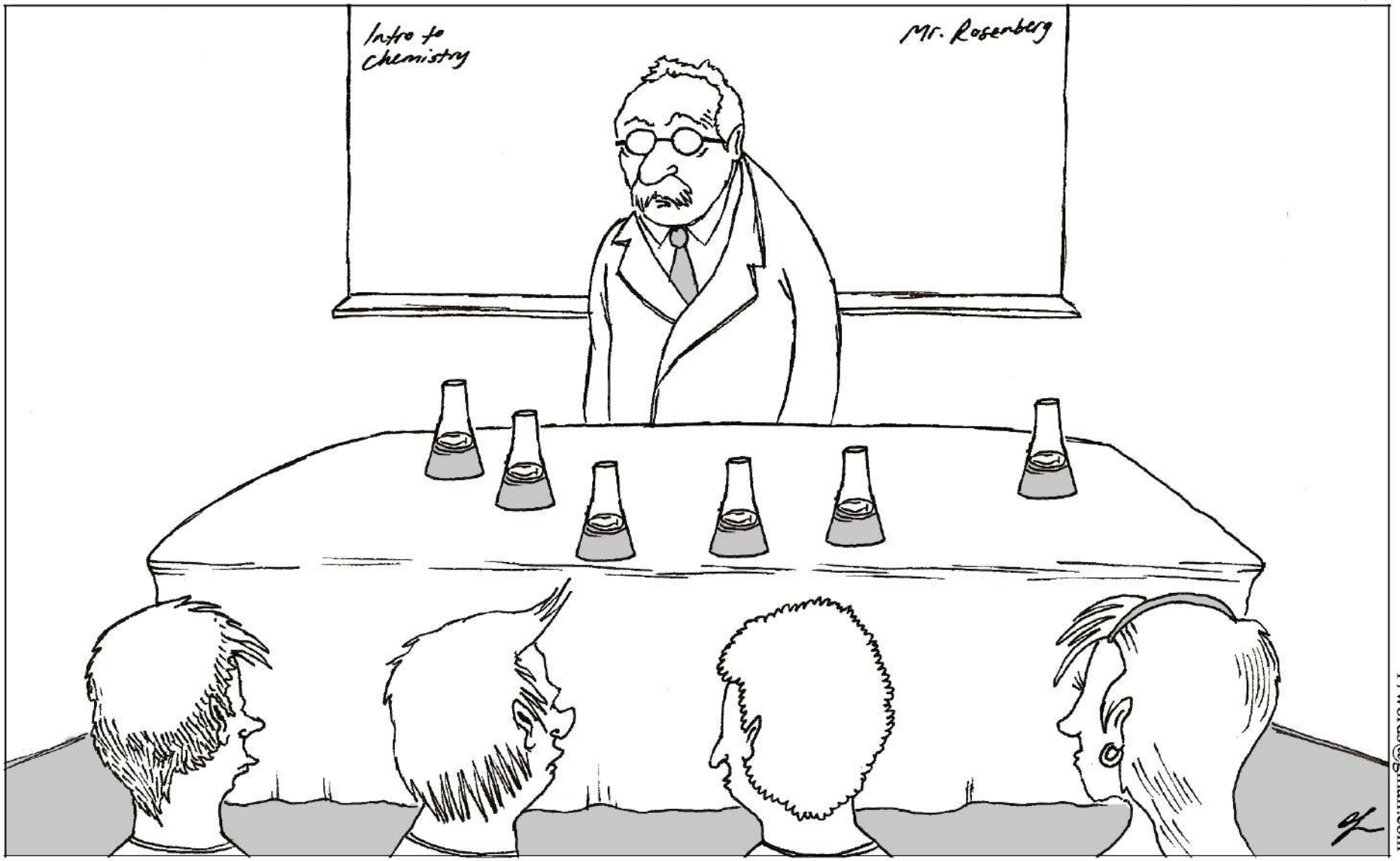
Separated

- Two types of mixtures:
  1. Homogeneous → uniformly mixed parts
  2. Heterogeneous → not uniformly mixed parts



- Mixtures can be separated by physical processes.
- Solution: a mixture where one substance (the solute) is dissolved in another (the solvent).

  →Water is the universal solvent.



"Good morning, class. Today we'll be studying some of the chemicals that three of your desks have been pre-treated with. Put your heads down at your own peril."

- **Acids and Bases**
- Acid: a substance that released H^+ ions when mixed with water.

→ Acids have a pH of 0 – 6.

Ex. $HCl \rightarrow H^+ + Cl^-$

- Base: a substance that releases OH^- ions when mixed with water.

→ Bases have a pH of 8 – 14.

Ex. $NaOH \rightarrow Na^+ + OH^-$

- A pH of 7 is neutral. It is neither acid nor base.

- The pH scale measures the concentration of H^+ ions in solution. The greater the concentration of hydrogen in the solution, the lower the pH. As the concentration of hydrogen in the solution decreases, the pH gets higher.

- The pH scale shows an exponential relationship.

- Each number on the pH scale represents a factor of 10. What does this mean?

→ An acid with a pH of 0 is 10 times stronger than an acid with a pH of 1 and it is 1,000,000 times stronger than an acid with a pH of 6.

- Acids and bases have the ability to neutralize each other.
- When an acid and a base of equal strength are mixed, the result is a neutral solution.

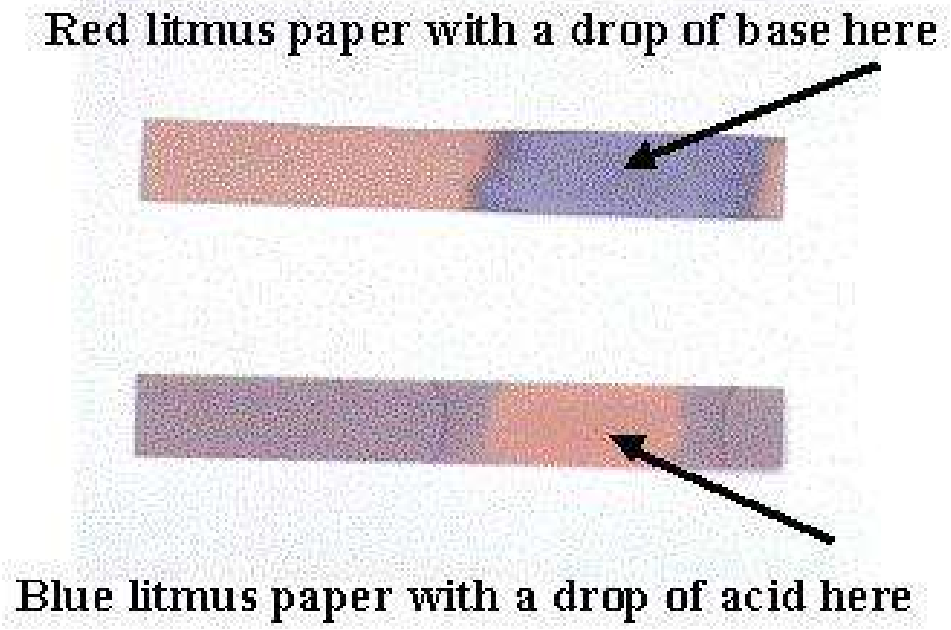
- Ex. $HCl + NaOH \rightarrow NaCl + H_2O$

- Every neutralization reaction will result in an ionic compound that is dissolved in water and the pH will always be 7.

- **Indicators**
- Indicators are chemicals that change color in the presence of other chemicals.

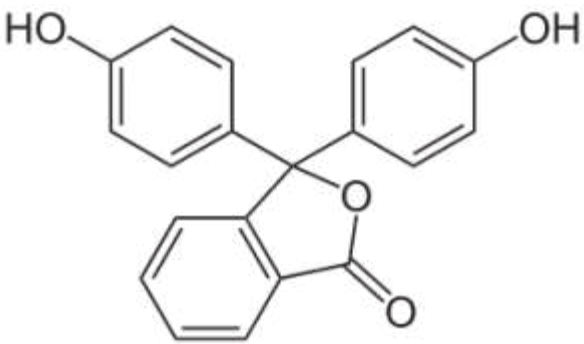
- There are many indicators that tell whether a solution is acid or base, but these are some of the most common:

→ Litmus paper: blue litmus turns red in an acid
red litmus turns blue in a base

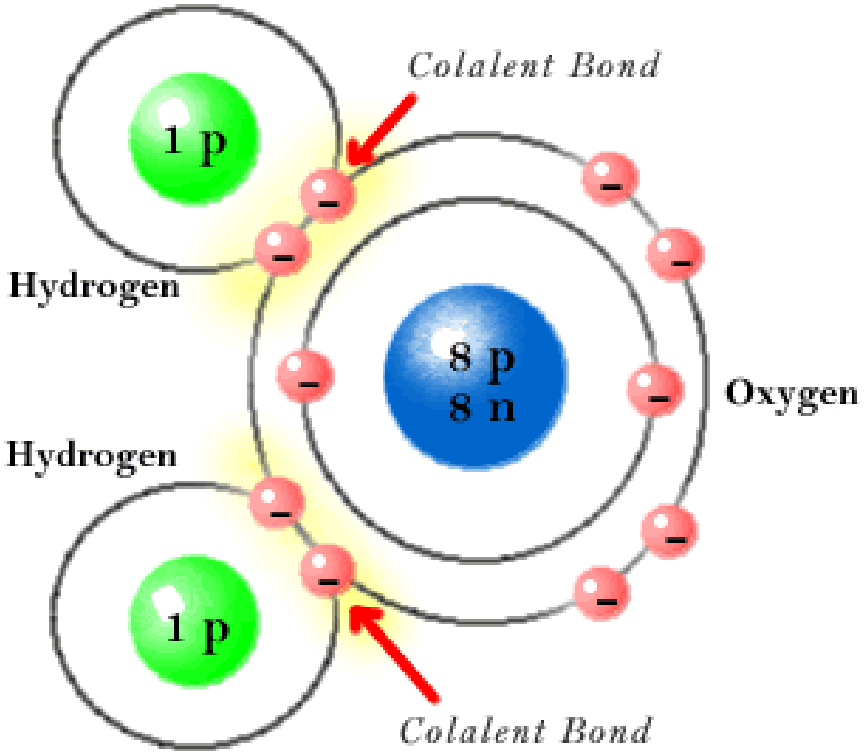


→Bromthymol blue: blue in a base and yellow in an acid

→Phenolthelein: colorless in an acid and pink in a base



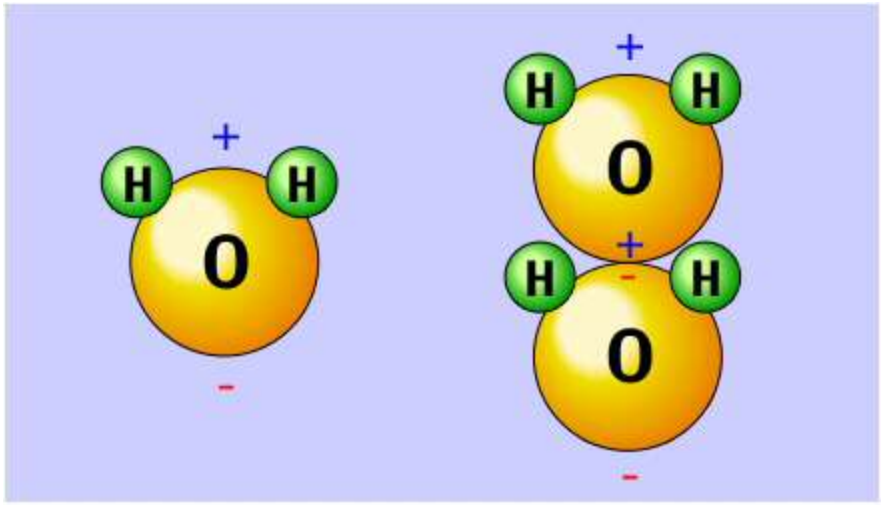
- **Properties of Water**
- Water is a polar molecule. This means that it bonds covalently, but electrons are not shared equally between the hydrogen atoms and the oxygen atom.



Bohr Model of H_2O

- Since more electrons can be found orbiting the oxygen portion of the molecule, that end has a negative charge.

- Since fewer electrons can be found around the hydrogen atoms that end has a positive charge.

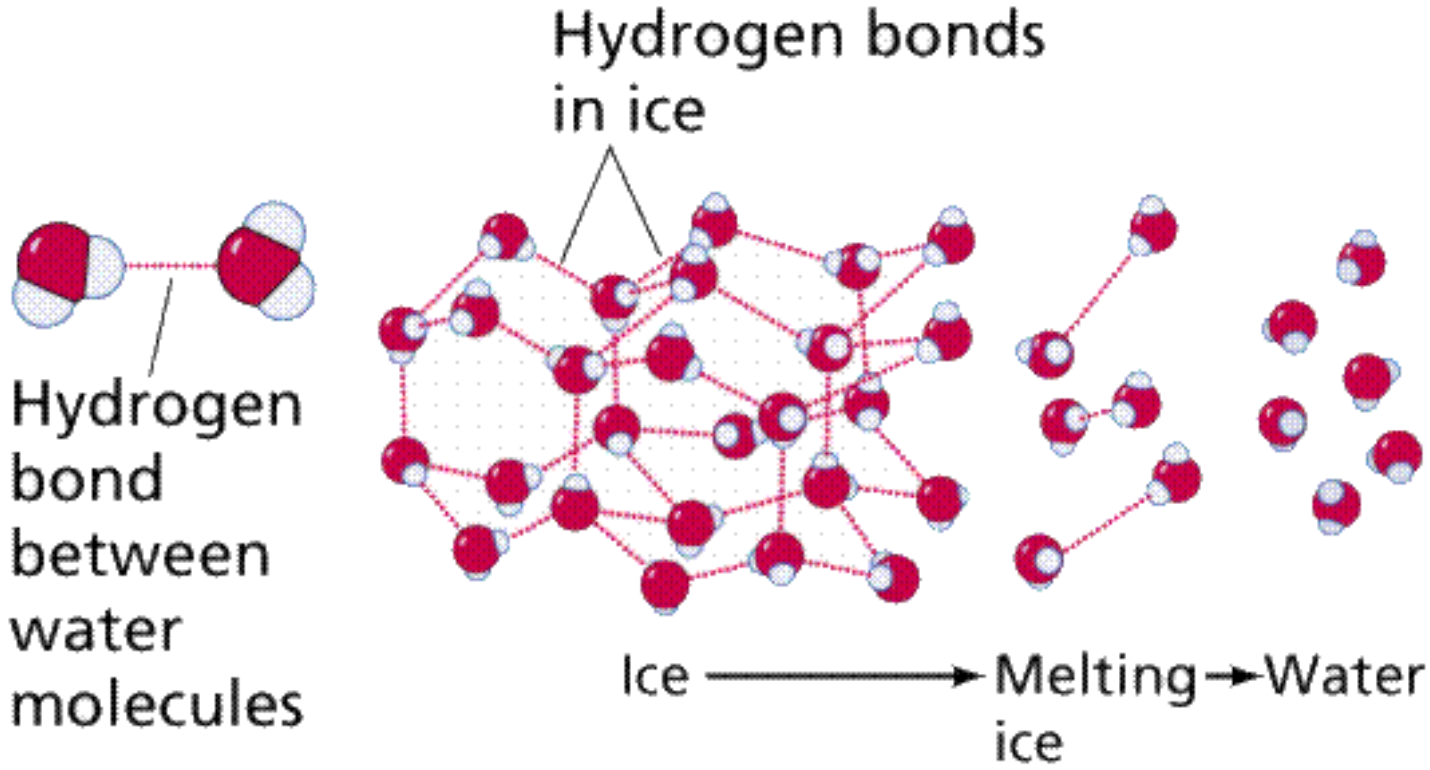


→Because of the difference in charge the molecule acts like a magnet.

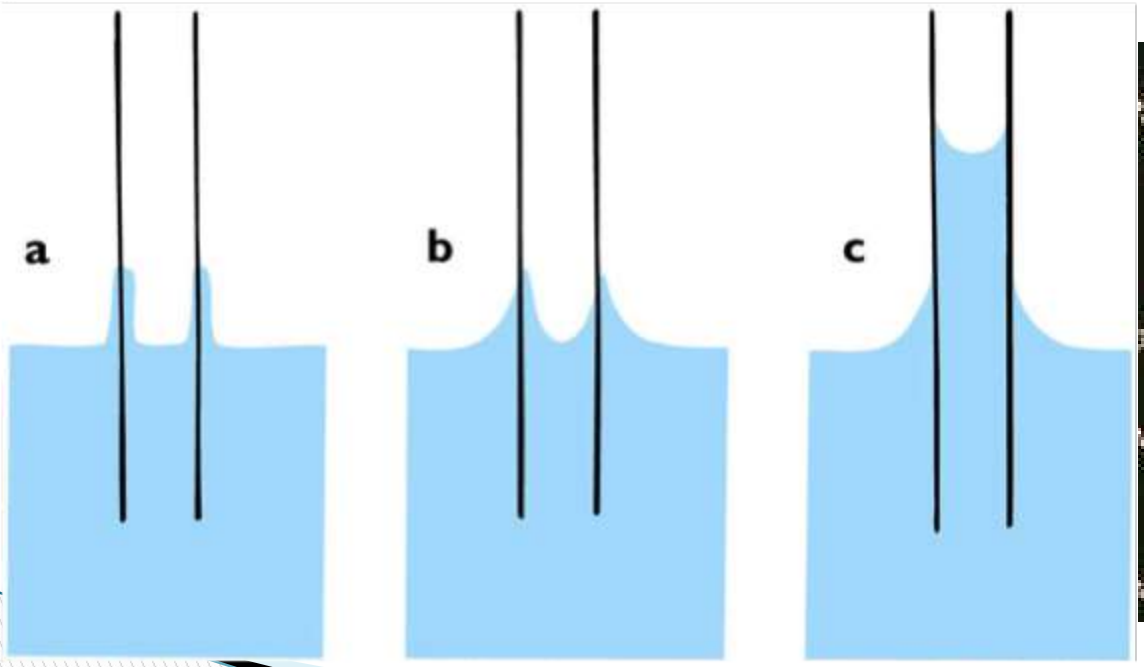
→The positive hydrogen end of the molecule attracts negative ions and compounds and the negative end attracts positive ions and compounds.

→Because of this attraction, ionic compounds (ex. Salt) and polar compounds (ex. Sugar) dissolve in water.

- Water molecules also attract other water molecules.
- This attraction forms a weak bond called a hydrogen bond.
- Hydrogen bonds hold many important molecules together (ex. Proteins).



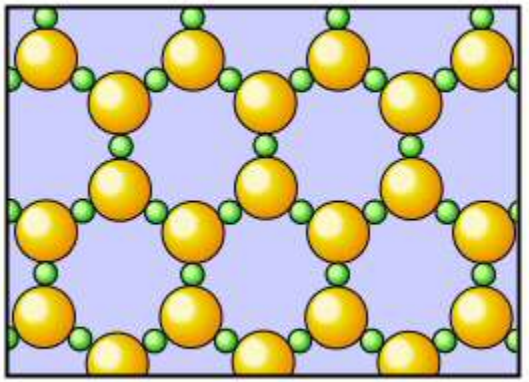
- The polarity of water is responsible for many of the unique properties of water.
- Adhesion is the tendency of water to stick to the walls of its container and is responsible for capillary action



- Cohesion is the tendency for water molecules to stick to each other and is responsible for surface tension
- Because of cohesive forces, it is difficult to move water molecules apart.

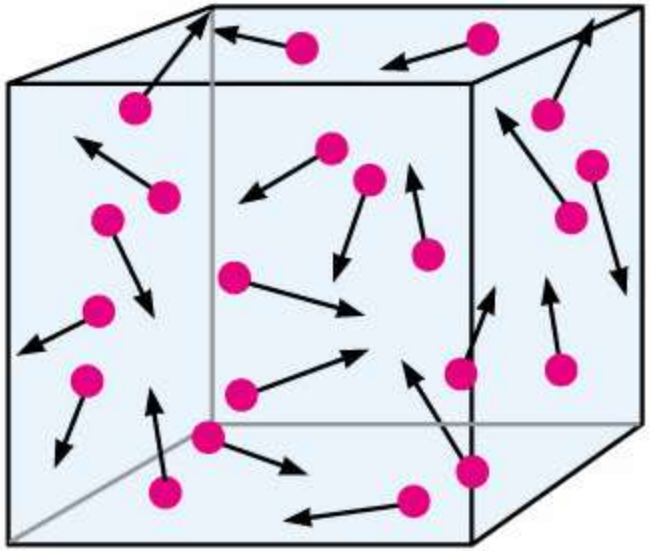
- For this reason, water is very slow to gain heat.
- Once the molecules have been moved apart, though they are difficult to move back together.
- For this reason, water is slow to lose heat, once it has been warmed.

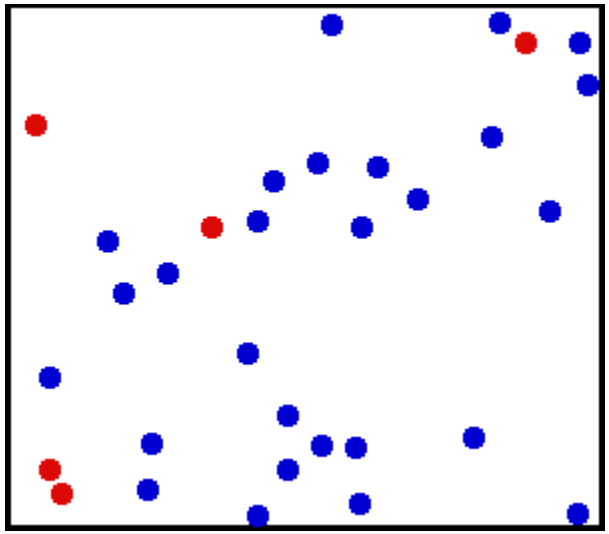
- Cohesive forces are also the reason that water expands when it freezes.
- The hydrogen bonds between water molecules are frozen in place, which makes the molecules less mobile, causing them to remain farther apart.



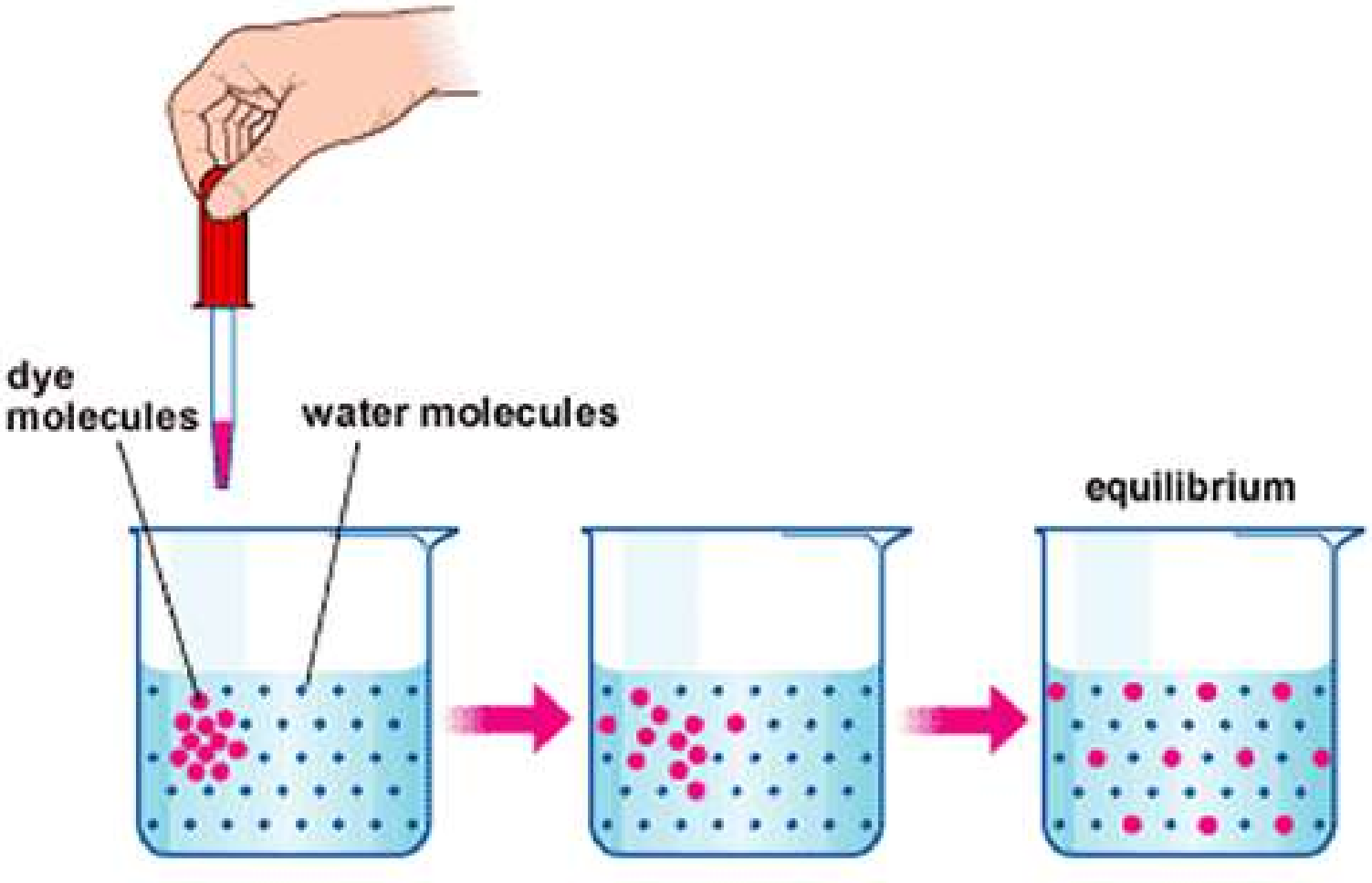
Ordered Molecular Structure of Frozen Water

- **Movement of molecules**
- Molecules of all substances are constantly in motion and are constantly trying to distribute themselves evenly. They do this spontaneously without the use of energy





- Diffusion is the movement of molecules from areas of higher concentration to areas of lower concentration. (Follows the concentration gradient.)



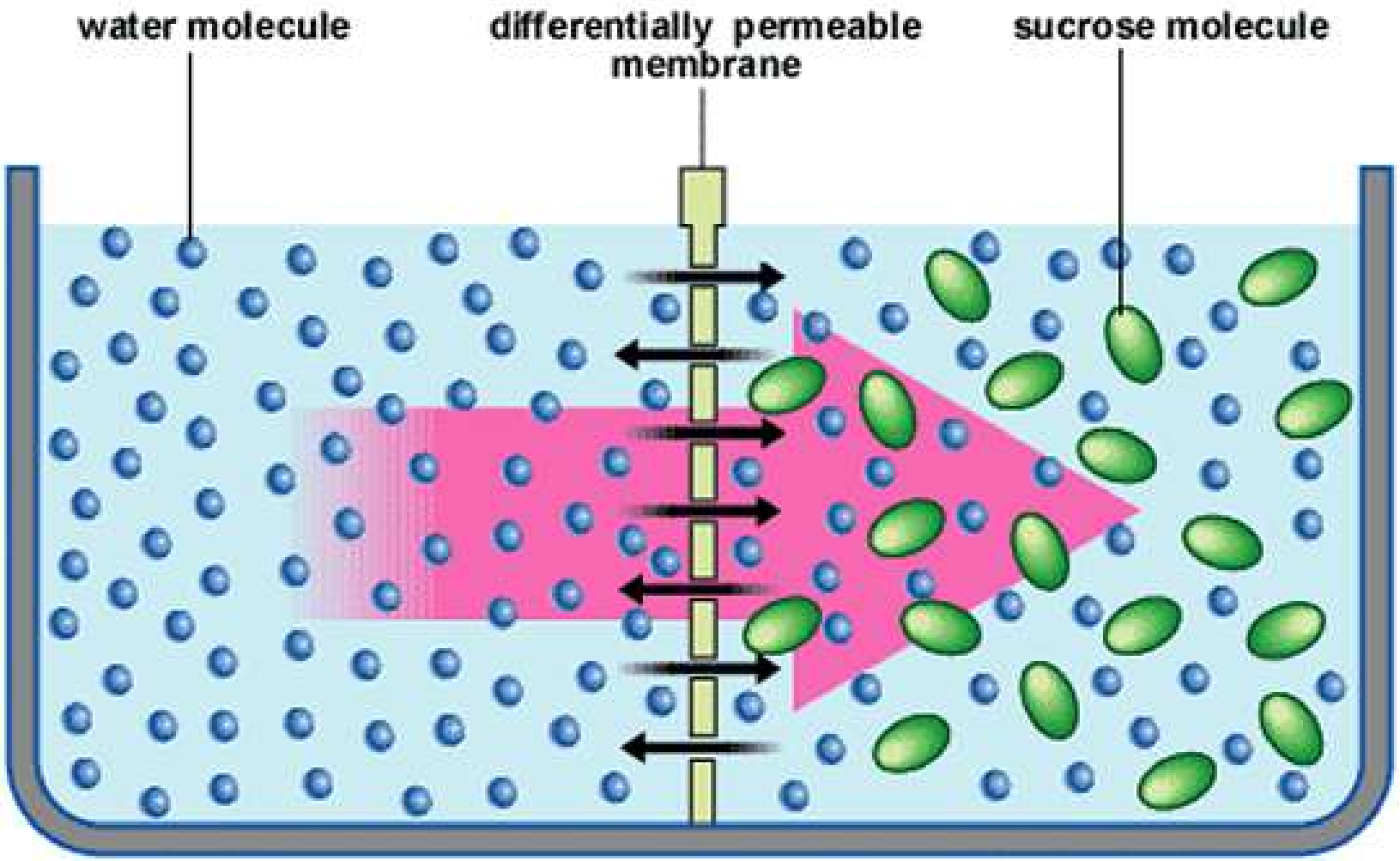
- *Factors affecting diffusion*:

1. Concentration
   Most important factor
   Steep concentration gradient = fast diffusion

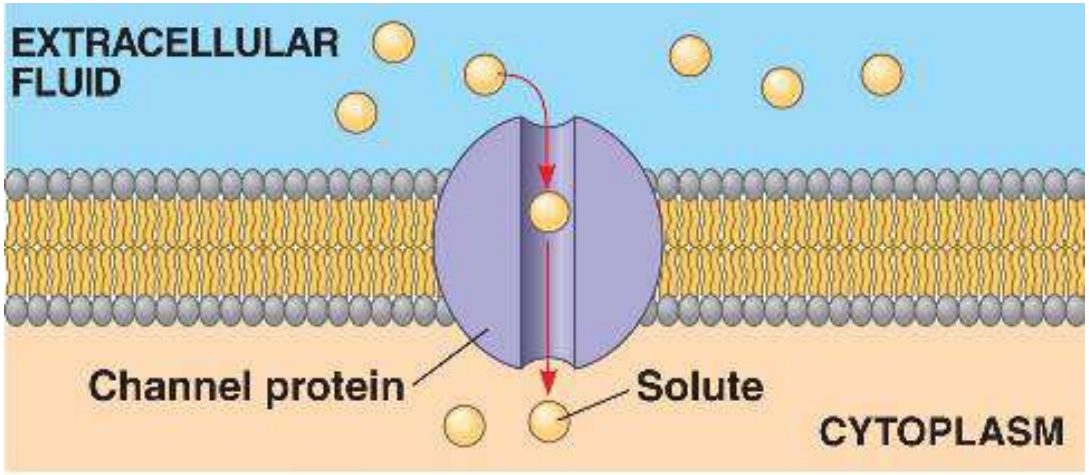
2. Temperature
   Higher temperature = fast diffusion

3. Pressure
   Higher pressure = fast diffusion

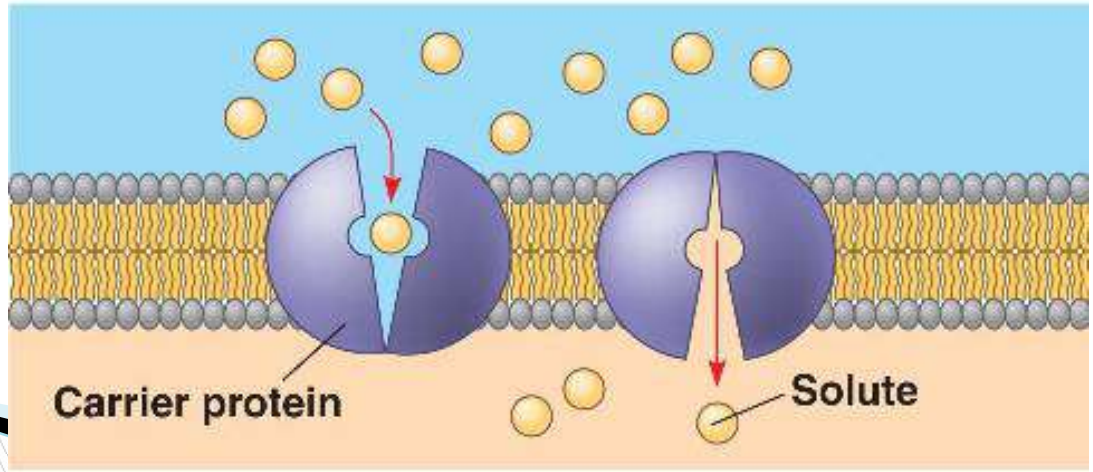
- Osmosis is the diffusion of water across a cell membrane



- Facilitated diffusion is the diffusion of large molecules using carrier molecules.



(a) A channel protein



(b) A carrier protein

- Active transport IS NOT a type of diffusion.

→ It moves molecules from areas of low concentration to higher concentration (against the concentration gradient.)

→ It uses energy.